


USING MYCORRHIZA IN ONION GROWING: RUSSIAN EXPERIENCE

M. Kostin¹, Candidate of Agricultural Sciences, Research Associate
I. Podkovyrov², Candidate of Agricultural Science, Associate Professor, Head of a Chair
The Institute of Forest, Russian Academy of Science, Russia¹
Volgograd State Agrarian University, Russia²

The feasibility of using mycorrhizal products in biological agriculture is shown in the paper. When growing onions it is reasonable to use the *Glomus* fungi. It was found out that the mycorrhiza on onion roots improves the plant growth in the early stages of ontogeny. The effectiveness of mycorrhizal fungi on light-brown soils is reducing under the influence of high temperatures and low humidity. The factors causing the stress reduce the plant immunity and lead to the need to use pesticides.

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In relation to the volume of consumption Onion is one of the major vegetable crops. Its gross yield in the world is eighty five million tons per year. According to the Food and Agriculture Organization of the United Nations there is a steady trend of onion consumption growth at the rate of two percent per year. As a result, it is necessary to look for ways to increase the yield of this crop [1].

Russia produces more than two million tons of onions per year. At the same time, from April to August the country has imported three hundred thousand tons of onions. At this period own reserves in storages are depleted. First of all, it can be overcome by increasing crop yields. After years of work large seed companies like Syngenta Seeds, Monsanto Holland, Bejo Zaden, Sakata Seeds have released high yielding hybrids. It is now possible to increase the yield of onion in Russia by 2-2.5 times [2].

In Russia, the Volgograd region is the biggest producer of onion. It accounts for 23% of total production in the country. However, the home market is satisfied by 91%. This provides the conditions for the onion production growth.

In the Volgograd region farmers grow onions of such hybrids as Banko, Candy, Manas, Margit, Hilton, and Exacta. They are able to ensure constant production from earliest to the latest days of the year.

The introduction of drip irrigation, fertigation and integrated protection of onion crop has increased yield to 80-85 tons per hectare. But this is not the limit. Genetically inherent potential of hybrid onion crops allows producing about 15-20% more.

What do we have for this path? Some farms increase the amount of mineral fertilizers in plant nutrition. But

this leads to deterioration in the quality of the bulbs. They do not have time to ripen during the period of cultivation. In further, the bulbs are stored poorly. In addition, high doses of fertilizers are bad for the soil and environment, as they worsen their condition.

Onion requires powerful soil nutrition. In fact, it is one of the most demanding vegetable plants. High yields of it are produced in light fertile soils with slightly acid or neutral reaction (pH 6-7).

Soil regions, where most of the onion is grown in Russia, have slightly alkaline reaction. This worsens the mineral nutrition of plants. Elements like phosphorus, potassium, calcium, and boron are poorly absorbed by onion plants.

The root system of onion is poorly developed. It consists of unbranched filamentous rootlets. Root hairs are not numerous. They penetrate to a depth of 40-50 centimeters. Using onion mycorrhiza we can improve the mineral nutrition of plants and increase productivity [3].

In Russia, preparations for the formation of mycorrhizae are not common. Farmers know very little about such possibility. There are only a few products in the market: Mikokorp, Mikoplant. And they are designed for amateur gardeners.

We have analyzed the experience of application of mycorrhizal onion in other countries. There are numerous recommendations for the use of fungi of the genus *Glomus*. However, the effect of *Glomus* fungi on the growth of onion on light-brown soils is poorly studied.

We tried to address several questions:

- How effective is fungi *Glomus* (mycorrhiza form) with onions?

- What kind of fungi can be recommended for cultivation of onions?
- How do the mycorrhizal fungi act in the soil?

In one of the farms of the Volgograd region, we have conducted a field experiment. In crops of onions of different hybrids we had the fungus culture. Control group consisted of sites without the preparation. Also we had a similar experiment in pots.

We have analyzed the plant growth and development, as well as the soil samples.

Studies have shown that the first signs of mycorrhiza formation appeared after 10-12 days after the preparation. During this period only a few roots of onion seedlings were formed. Therefore, the development of the fungi in the roots is going poorly.

Maximum growth of mycorrhiza on the roots is observed 20-25 days after the sprouting of onions. At this time the plants grow very quickly. The root system is being developed. It is spreading across the volume of soil. In the experiments several types of fungi were applied: *Glomus*: *G. mosseae*, *G. soronatum*, *G. caledonium*, and *G. geosporum*.

The best results in mycorrhiza formation on light-brown soils were shown by the species *Glomus mosseae* and *caledonium*. There is a strong connection between onion and mycorrhizal plants. This compatibility may be of particular importance, since the onion has straight long roots. Plants of onions with fungi of the genus *Glomus* form the arbuscular mycorrhiza. On the surface, the vesicles are formed on the roots. More arbuscular mycorrhiza is formed during ten days. They are located on the roots at a distance of

Table 1.
Assessment of efficiency of cultivation of onion hybrids with the use of mycorrhizae

Hybrids	Level stability growth score	Level development score	Yield		The rating of the hybrid for the efficiency of cultivation
			potential, t/ha	the actual t/ha / % mismatch	
With the use of mycorrhizae					
Banco F ₁	4,8	4,7	100,0	85,06 / 14,94	I
Rossa de Ference F ₁	4,0	4,5	90,0	80,4 / 10,67	III
Gladstone F ₁	3,6	4,5	85,0	81,42 / 4,21	II
Without mycorrhizae					
Banco F ₁	4,2	3,9	85,0	75,06 / 11,69	V
Rossa de Ference F ₁	3,8	3,6	90,0	80,4 / 10,67	IV
Gladstone F ₁	3,3	3,6	70,0	62,68 / 10,46	VI

30-50 microns from each other. Formation of vesicles occurs in the middle of the root. Their main portion is located at a depth of up to 18-21 centimeters.

We have revealed that formation of hybrid mycorrhiza occurs at about the same time. In our experiments, significant differences in the process of formation have been revealed. The formation of mycorrhiza positively affects the growth of onions plants. We have compared the intensity of growth of plants without mycorrhiza and with mycorrhiza on the roots. The positive effect is - the growth rate of leaves increases by 23-26%.

Prediction of onions plant growth using the logistic function. The use of mycorrhizal fungi can increase the yield of crops by 12-14%. Productivity can reach up to seven hundred and ninety - one hundred tons. The field experiment in plants with mycorrhiza on the roots showed no cases of violation of mineral nutrition. In control plants yellowing of all leaves due to lack of potassium and other elements was observed.

Unfortunately, the mycorrhiza on onions cannot protect plants from diseases completely. In mid-June peronosporosis appeared on onion crops. In Russia there are no effective biological control agents against this disease. Therefore, the chemical method of dealing with the disease is used systemically (mainly Ridomil Gold).

After chemical treatment the mycorrhiza formation on onion plants has stopped. Crops have aligned in growth and development. There were no significant differences between the control and the experimental group (table 1).

We have noted the positive effect of mycorrhizal fungi in the soil. The microbiological activity of the soil after introduction of the *Glomus* spores into onion crops has increased by 16-22%. Mineralization of organic matter is active. By the end of the growing season the soil plots, where mycorrhiza was applied, contained more nutrients.

Glomus fungi spores have survived in the soil in spite of chemical treatment of onion plants. When onions are re-planting on these sites mycorrhiza is formed again. Application of the *Glomus* fungi has long duration of action, which is important for agrocenosis and the soil.

Thus, the use of mycorrhizae can improve the growth onion plants and increase the productivity of crops. As a result of its application the soil condition is also improved. This is important for the greening of agriculture.

References:

1. Khvan O.V. The use of growth stimulants and magnetic water to improve the quality of seedlings of onion., O.V. Khvan., Proceedings of International Scientific and Practical

E-Conference on Agriculture and Food Security «Anthropogenic evolution of modern soils and food production under changing of soil and climatic conditions», 28 November, 2015, Access mode: <http://e-conf.rjoas.com>.

2. Khvan O.V., Podkovyrov I.Y. Forecasting of onion hybrids' growth on light-chestnut soils., O.V. Khvan, I.Y. Podkovyrov., Russian Journal of Agricultural and Socio-Economic Sciences, ISSUE 1(49), January 2016., pp. 79-84. <http://dx.doi.org/10.18551/rjoas.2016-01.10>

3. Shuab R., Lone R., Naidu J., Sharma V., Imtiyaz Sh., Koul K. Benefits of Inoculation of Arbuscular Mycorrhizal Fungi on Growth and Development of Onion (*Allium cepa*) Plant., American-Eurasian J. Agric. & Environ. Sci., 14 (6): 527-535, 2014., pp. 527-535.

Information about authors:

1. Maxim Kostin – Candidate of Agricultural Sciences, Research Associate, Russian Academy of Sciences - Institute of Forest Science; address: Russia, Volgograd city; e-mail: mwkostin@yandex.ru

2. Igor Podkovyrov – Candidate of Agricultural Science, Associate Professor, Head of a Chair, Volgograd State Agrarian University; address: Russia, Volgograd city; e-mail: parmelia@mail.ru